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PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO SCREW EXTRUDERS

(71) I, HANS ULRICH BREDEMAYER, a German citizen of 3 Hannover, An der Trift 8 A, Federal Republic of Germany trading as PAUL TROESTER MASCHINENFABRIK, a German Company of 3 Hannover-Wülfel, Am Brabrinke 2-4, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a screw extruder of the kind comprising a die and a cylinder to which is attached an extrusion head which is formed of two parts, said two parts being pivotally attached to the cylinder through hinge arrangements and being clamped together in operation, the die comprising exchangeable plates.

A screw extruder of this kind is already known. It has the advantage that the two parts of the extrusion head can easily be swung away so that the machine can readily be cleaned, the head parts being swung away to the sides and thus leaving space for the screw to be withdrawn. In the operation of such a screw extruder, the die often has to be exchanged without any need to change the material being processed, for example, in the tyre industry in the manufacture of tread bands for tyres of different sizes. To this end, the die is formed by exchangeable die plates. These exchangeable plates are generally screwed to the respective halves of the extrusion head.

In one known extruder of the type aforementioned only one part of the extrusion head has the form of an exchangeable plate, although an additional plate is also provided. The additional plate is screwed to its associated extrusion head half, whilst the exchangeable plate is clamped in position by means of a wedge-shaped locking arrangement, the locking component of said arrangement being

moved perpendicularly to the longitudinal axis of the extruder. This clamping arrangement, however, has the disadvantage wherein, during clamping of the plate, the force is exerted not only in the direction of the longitudinal axis of the extruder but also perpendicularly thereto. Consequently, the shape of the die is affected because the plate can deflect. For this reason, this method of attacking the plate as been discarded, and the use of a screw attachment has been employed instead. With this latter method, however, the exchange of a die plate takes a considerable amount of time.

An object of the present invention is to provide a screw extruder in which the exchangeable plates can be urged into position without distorting said plates.

According to the invention, there is provided a screw extruder comprising an extrusion cylinder having attached thereto an extrusion head in two parts which together form a die, said parts being pivotally attached to the cylinder and holding respective die plates between which an extrusion outlet passage is defined, said extruder further comprising a lever arrangement and a servo-motor to operate said arrangement in a manner such as to urge at least one of the die plates against its respective extrusion head with a force whose component perpendicular to the direction of extrusion is substantially zero. In this way, the plates can readily be pressed into position without distorting said plates, and can equally readily be released.

Preferably, there is provided a separate said lever arrangement for each die plate.

In one embodiment, each lever arrangement comprises a respective pair of levers articulated to respective extensions of the extrusion head.

In a further embodiment, each lever arrangement comprises a respective pair of levers mounted on a pivot pin forming a hinge carrying its respective extrusion head part.

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- Preferably, each extrusion head part has arranged thereon a stop for limiting motion relative to that part of a lever of the associated one of said lever arrangements.
- Expediently, each said lever extends through a respective opening arranged in an extension of a respective extrusion head part said extension serving as said stop.
- Alternatively, each said lever is arranged to engage in a hook arranged on a respective extrusion head part, said hook serving as said stop.
- Preferably, the or each said servo-motor is mounted on the extruder cylinder.
- Preferably, the or each servo-motor is arranged to produce operating motion in a direction parallel to the extrusion direction.
- Expediently, the or each servo-motor is arranged to operate the or a respective lever arrangement via mechanical coupling elements via which the or each motor is also coupled to clamps or a respective clamp for clamping the extrusion head halves.
- The or each servo-motor may be operated hydraulically.
- Figure 2 is a diagrammatic front elevational view of the extruder shown in Figure 1;
- Figure 3 is a diagrammatic sectional view in accordance with Figure 1, with the levers released and the plates removed; and
- Figure 4 shows diagrammatically a section through the forward part of the extruder with the extrusion head halves opened.
- The illustrated extruder comprises a screw 2 which is arranged inside a cylinder 1. Towards the front end of the extruder, i.e. the end thereof remote from the screw 2, the extruder is closed off by an extrusion head which comprises two halves 3 which are provided at the forward ends thereof with plates 4 which seat in further plates 5. In operation, the plates 4 are each pressed into position against the further plates 5 by means of a respective pair of levers 6 a free end of each of which bears against one of plates 4. Each lever 6 is fulcrumed at a respective pivot point 7 arranged on a respective extension 8 attached to respective extrusion head halves 3. Each of the extensions 8 also carries a stop 9 for its respective lever 6. Centrally between the two levers arms of each pair, each lever 6 is articulated to one end of a respective hydraulic servo motor 10 by means of a pivot pin 11. Each hydraulic servo motor 10 comprises a piston-and-cylinder arrangement and is articulated at its other end to a respective pivot point 12 through a respective extension 13 on the extruder cylinder 1.
- The two wide extrusion head halves 3 are articulated to respective extensions 15 at points 14, the extensions 15 being attached to the extruder cylinder 1. For constructional reasons, there is also an extension 16 between the hinge and the wide head half 3. This extension 16 is used to off-set the point of articulation further outwards, and the two extrusion head halves 3 are designed to be clamped together by pivoting clamps 17. Actuation of each of these clamps, with their in situ wedge, is effected in the axial direction of the worm by means of respective servo-motors 10.
- In Figure 1, the head has been shown in the closed position. The two plates 4 are here shown pressed into contact by the levers 6, the pressing force having substantially no component perpendicular to the direction of extrusion.
- In Figure 3, the position is shown in which the levers 6 are released so that the plates 4 can be removed whereby it is possible to slide or insert other plates into the head halves 3, which plates are then again pressed into position by the levers 6. To this end, the pistons of respective hydraulic servo motors 10, are displaced through only a small stroke, under quite a low pressure.
- After the clamps 17 (Figure 2) have been opened and pivoted away, the position of the hydraulic servo motor 10 can be displaced further so that the levers 6 which abut against the stops 9, displace the extrusion head halves 3 in the manner shown in Figure 4. In this fashion, full opening of the extruder is produced so that the worm 1 can easily be extracted.
- In this fashion, by means of a short piston stroke on the part of each hydraulic servo motor 10, the levers can be released so that the plates can be rapidly and simply exchanged. If the pistons are displaced further, the extrusion head valves are moved apart in a very simple manner so that the machine and in particular the extrusion head can readily be cleaned internally.
- For constructional reasons and for reasons associated with proper force transmission in the desired direction, it is advantageous if the levers 6 are double-armed, if one arm is articulated to the extension or to the pivot pin, if the free arm of the lever engages against the plate and if each hydraulic servo motor 10 engages between two arms.
- A particular advantage where the major mechanisation of the opening motions is concerned, is obtained by the hydraulic servo motors taking over the work of opening the extrusion head halves. As will be appreciated, this is made possible by virtue of the fact that the levers 6 are allowed to come up against stops 9 to the process of removing load to the plates, said stops 9

5	being fixed to the extrusion head halves, so that the force of the hydraulic servo motors is transmitted through the levers 6 to the stops 9 and thus to the extrusion head halves, in order to produce the opening motion.	4. A screw extruder as claimed in Claim 2 or Claim 3, wherein each lever arrangement comprises a respective pair of levers mounted on a pivot pin forming a hinge carrying its respective extrusion head part.	55
10	From a constructional point of view, the design of stops 9 is very simple and robust, especially if the levers are arranged to pass through openings of extensions of the extrusion head halves, said extensions acting as lever stops. Another possibility is to arrange for the levers to engage in a hook arranged on the extrusion head halves, the hook doing duty as a stop vis-a-vis the levers.	5. A screw extruder as claimed in any one of Claims 2 to 4 wherein each extrusion head part has arranged thereon a stop for limiting motion relative to that part of a lever of the associated one of said lever arrangements.	60
15	It is possible, furthermore, to arrange for the two hydraulic rams of motors 10 to perform a clamping operation. The clamps which hold the two injection head parts together are conventionally operated by hydraulic servo motors. The method adopted here is to provide, between the hydraulic servo motors and the levers 6, mechanical coupling elements by means of which the hydraulic rams can be coupled on the one hand to the levers and on the other to the clamps which are used to clamp the extrusion head parts in position.	6. A screw extruder as claimed in Claim 5, wherein each said lever extends through a respective opening arranged in an extension of a respective extrusion head part said extension serving as said stop.	65
20		7. A screw extruder as claimed in Claim 5, wherein each said lever is arranged to engage in a hook arranged on a respective extrusion head part, said hook serving as said stop.	70
25		8. A screw extruder as claimed in any one of the preceding claims, wherein the or each said servo-motor is mounted on the extruder cylinder.	75
30	WHAT WE CLAIM IS:—	9. A screw extruder as claimed in Claim 8, wherein the or each servo motor is arranged to produce operating motion in a direction parallel to the extrusion direction.	80
35	1. A screw extruder comprising an extrusion cylinder having attached thereto an extrusion head in two parts which together form a die, said parts being pivotally attached to the cylinder and holding respective die plates between which an extrusion outlet passage is defined, said extruder further comprising a lever arrangement and a servo-motor to operate said arrangement in a manner such as to urge at least one of the die plates against its respective extrusion head with a force whose component perpendicular to the direction of extrusion is substantially zero.	10. A screw extruder as claimed in any one of the preceding claims, wherein the or each servo motor is arranged to operate the or a respective lever arrangement via mechanical coupling elements via which the or each motor is also coupled to clamps or a respective clamp for clamping the extrusion head halves.	85
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45	2. A screw extruder according to Claim 1 wherein there is provided a separate said lever arrangement for each die plate.	11. A screw extruder as claimed in any one of the preceding claims, wherein the or each said servo motor is hydraulically operated.	95
50	3. A screw extruder as claimed in Claim 2, wherein each lever arrangement comprises a respective pair of levers articulated to respective extensions of the extrusion head.	12. A screw extruder substantially as hereinbefore described with reference to, and as illustrated in, the drawing forming part of this Specification.	

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1521756 COMPLETE SPECIFICATION

3 SHEETS

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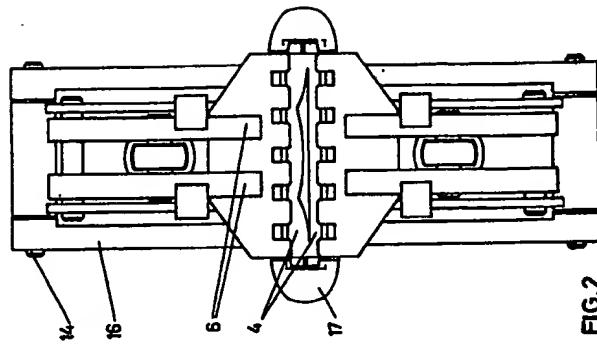


FIG.2

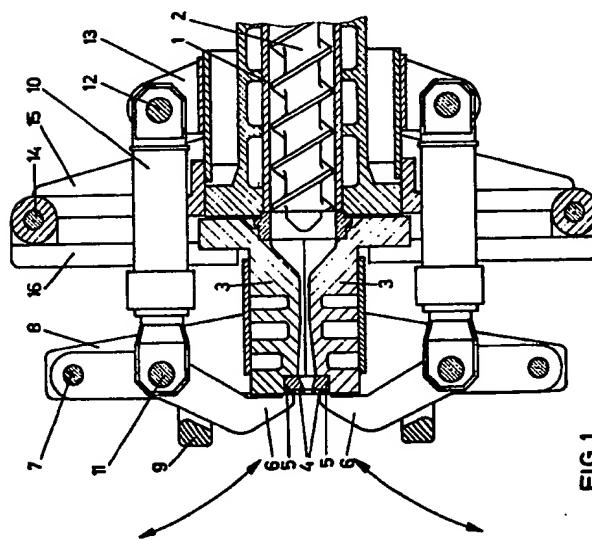


FIG.1

1521756 COMPLETE SPECIFICATION

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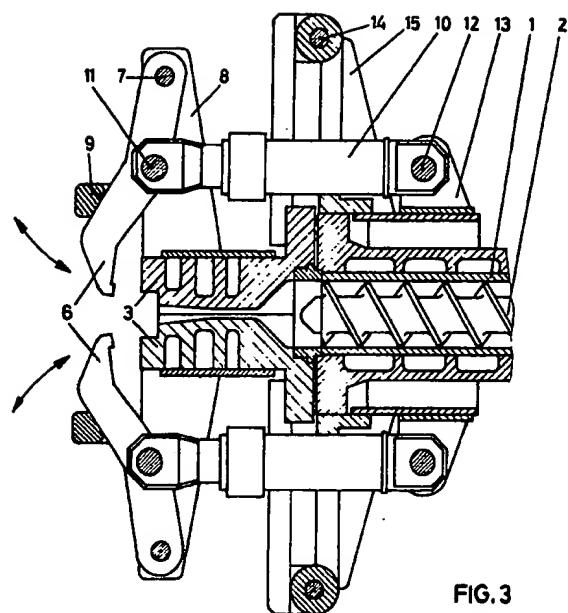


FIG. 3

1521756 COMPLETE SPECIFICATION

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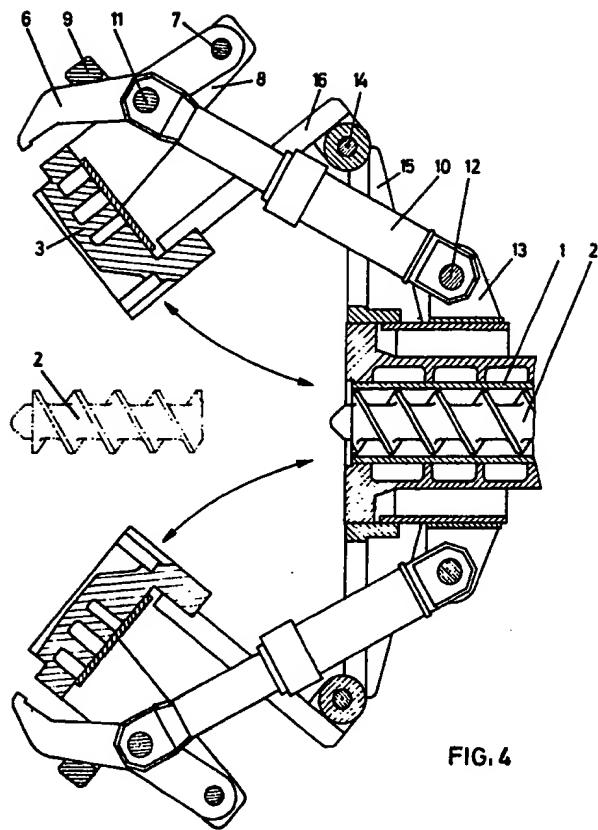


FIG. 4